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Indian Standard

DIMENSIONS OF LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR — STANDARDIZED MOUNTING ON RAILS OF MECHANICAL SUPPORT OF ELECTRICAL DEVICES IN SWITCHGEAR AND CONTROLGEAR INSTALLATIONS

ICS 29.120.60

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NEW DELHI 110002

October 2007 **Price Group 9**

Low-Voltage Switchgear and Controlgear Sectional Committee, ET 07

NATIONAL FOREWORD

This Indian Standard which is identical with IEC 60715 : 1981 'Dimensions of low-voltage switchgear and controlgear — Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Low-Voltage Switchgear and Controlgear Sectional Committee and approval of the Electrotechnical Division Council.

This standard supersedes IS 11039 : 1983 'Requirements for mounting on rails in switchgear and controlgear installations'.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

Amendment No. 1 to the above International Standard has been given at the end of this standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

DIMENSIONS OF LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR — STANDARDIZED MOUNTING ON RAILS OF MECHANICAL SUPPORT OF ELECTRICAL DEVICES IN SWITCHGEAR AND CONTROLGEAR INSTALLATIONS

INTRODUCTION

The problem of mounting devices, that is switches, circuit-breakers, relays, contactors, terminal blocks, etc., within an assembly in such a manner that they may be easily initially fixed, removed or rearranged, has been studied during the last few years by an increasing number of groups of manufacturers and users.

A solution which has already found a degree of "natural standardization" in a number of highly industrialized countries is rail mounting, for example steel or aluminium sections onto which is attached any device of any group within a certain physical size.

Using the rail method, initial fixing, removal or rearrangement of components within an assembly is readily carried out.

Two methods are used for fixing a device on a rail:

- either directly by clipping on the rail (this method is particularly suitable for "Top hat" rails or "G" rails);
- or by means of a variety of accessories such as sliding nuts and hooked or "T" headed bolts (this method is particularly suitable for "C" rails).

In the case of "G" rails, the first of these methods has been mainly used for mounting terminal blocks which snap in and out of position and are clamped in rows by adjustable end stops.

One or more rails can be used as necessary for fixing devices.

The rail may take the form of a standard section as an integral part of the enclosure.

Rails are also available of composite sections which combine, for example, "Top hat" and "C" section sizes thus accepting devices with various arrangements for mounting.

Since rail mounting may affect the performance of equipment, it may be advisable for equipment manufacturers to give guidance in their literature on the suitability for this form of mounting.

1. Scope

This standard specifies dimensional and functional requirements for the compatible mounting of varied electrical devices on some types of rails in switchgear and controlgear assemblies.

Appendices deal with specific steel mounting rails satisfying the requirements of this standard, and give additional dimensional data and loading requirements applicable to such rails.

2. Object

The object of this standard is to specify those dimensions which are critical for the correct design of rails and equipment. The following sections are covered by this standard:

- "Top hat" section;
- "C" section;
- "G" section.

Notes 1. — The detailed design and material of specific steel rails is given in the appendices.

2. — Mounting compatibility does not imply functional interchangeability.

3. — Other types of rails and relevant mountings which are not covered by this standard can be used.

3. Functional requirements

The basic functional requirement of mounting rails is that they shall adequately support the electrical equipment.

The rail itself, in combination with the distance between the points of support and the nature of these supports, shall be of sufficient mechanical strength and stiffness to endure the static and dynamic load of the equipment.

Note. — The performance of the equipment mounted on rail should be verified to ensure correct operation.

Because of the great variety of equipment, and of combinations of equipment, and the spatial distribution of such equipment, it is not possible to state specific requirements that ensure proper performance under all conditions; however the detailed dimensions and the strength requirements given in Appendix A and Appendix B have been shown by experience to be suitable for use with a variety of equipment such as contactors, fuses, switches, terminal blocks and circuit-breakers.

The responsibility for the correct construction and choice of materials lies with the manufacturer of the complete assembly.

4. Standard dimensions

The dimensions given in millimetres are those which are critical for the correct design of the rail and the equipment to be mounted thereon.

4.1 *Top hat section*

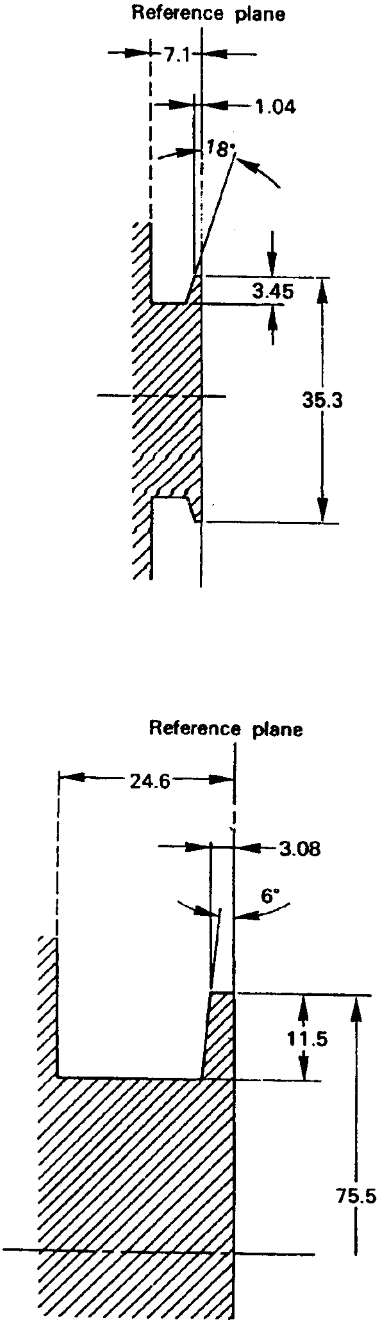


FIGURE 1

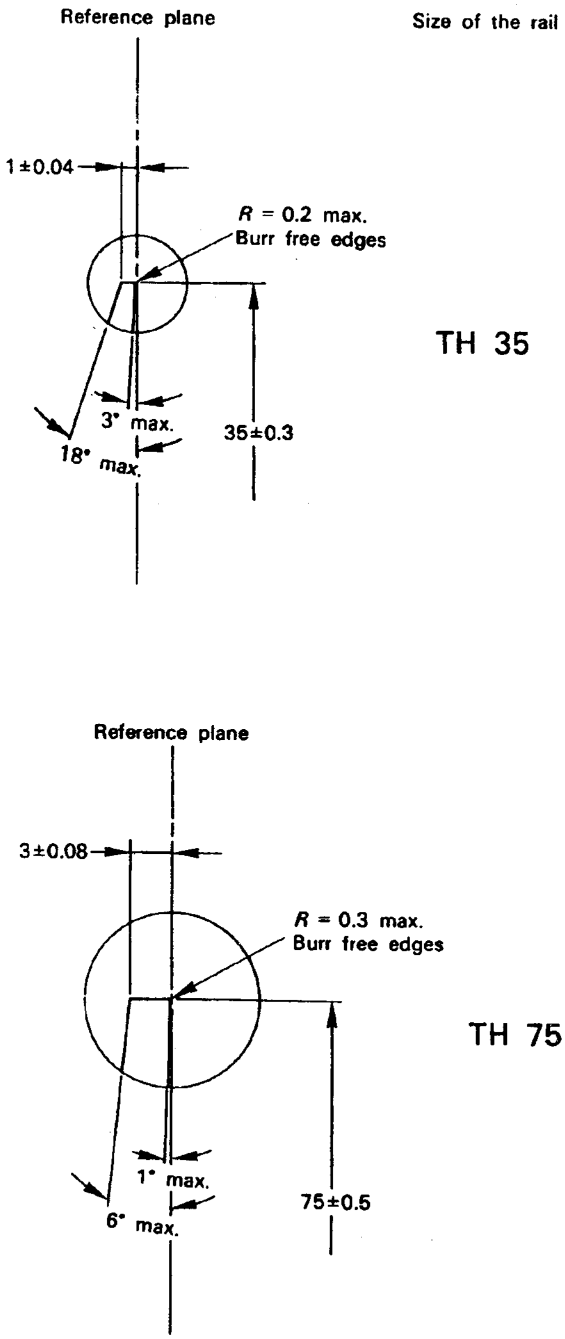


FIGURE 2

The reference plane is a plane touching the front of the rail.

In Figure 1, page 11, the cross-hatched area shows the maximum space available for the rail, its supporting structure and fixing means. The remaining space is the maximum space which can be counted on as available for the equipment to be mounted on the rails.

Figure 2, page 11, shows magnified details of the edge of the rails, including the manufacturing tolerances. The rails are symmetrical within the given tolerances. The angular tolerances indicated are one-sided and shall remain between zero and the values indicated. They include design tolerances.

4.2 *"C" section*

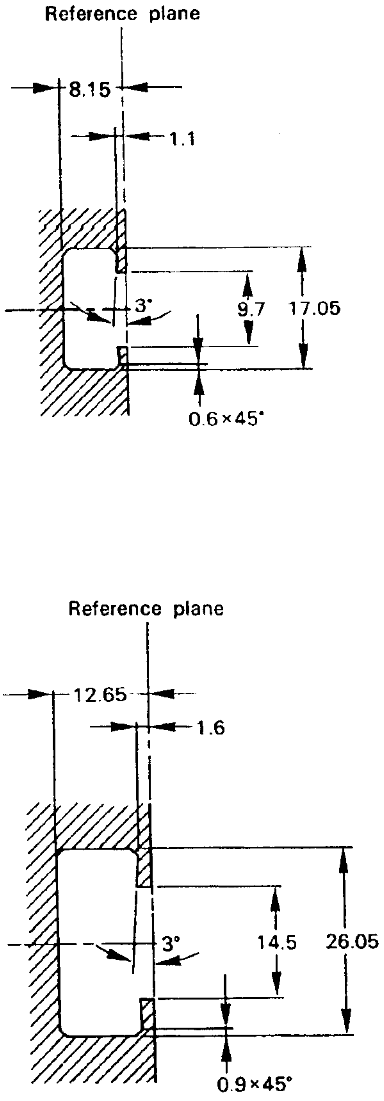


FIGURE 3

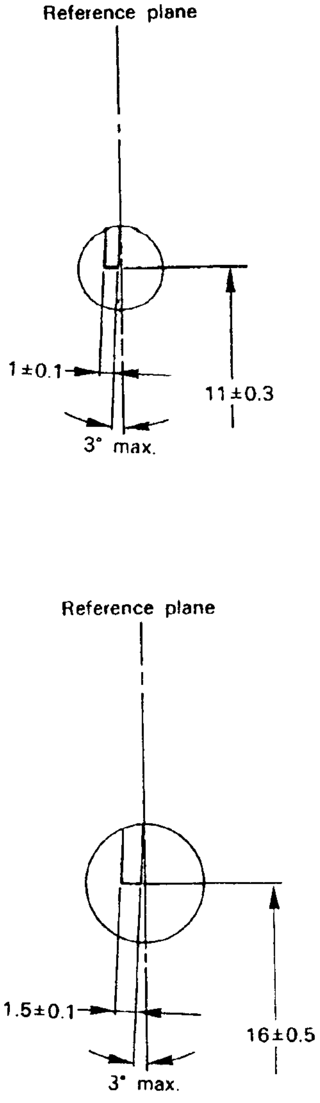


FIGURE 4

Size of the rail

C20

C30

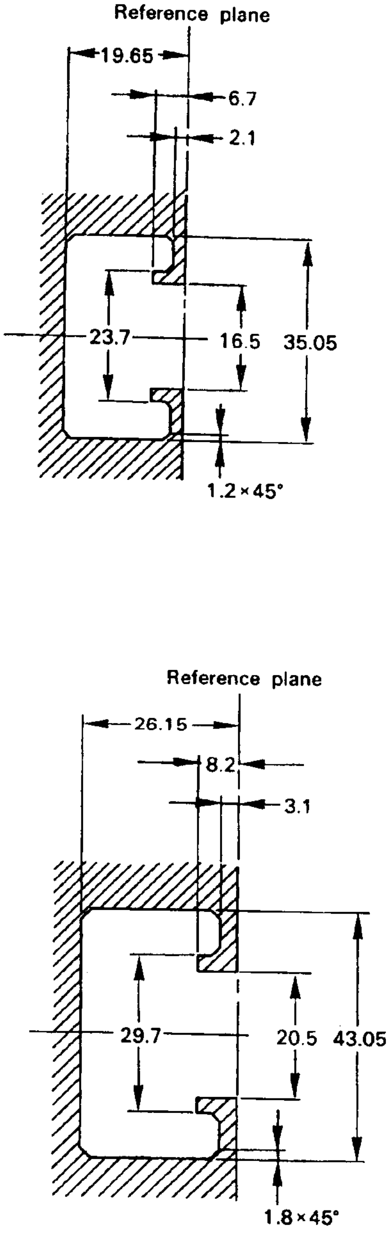


FIGURE 5

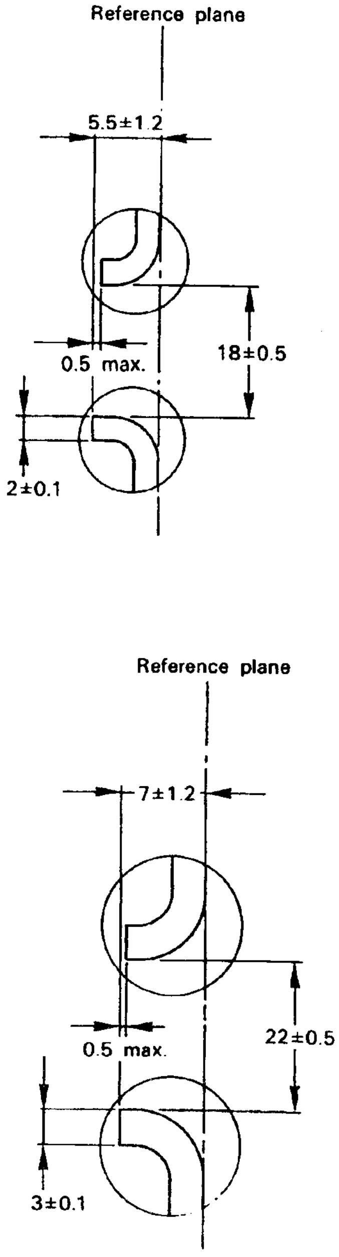


FIGURE 6

Size of the rail

C40

C50

The reference plane is a plane touching the front of the rail.

In Figure 3, page 13, and in Figure 5, the cross-hatched area shows the maximum space available for the rail and its supporting structure; it does not take into account the fixing means for the rail. The remaining space is the maximum space which can be counted on as available for the equipment to be mounted on the rail.

Figures 4 and 6, pages 13 and 15 respectively, show magnified details of the edge of the rail, including the manufacturing tolerances. The rails are symmetrical within the given tolerances. The angular tolerances indicated are one-sided and shall remain between zero and the values indicated. They include design tolerances.

4.3 *"G" section*

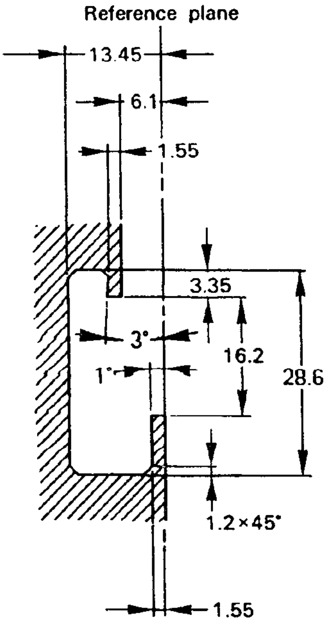


FIGURE 7

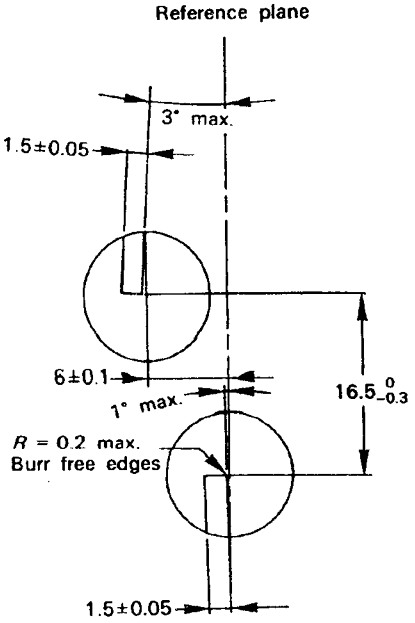


FIGURE 8

Size of the rail

G32

The reference plane is a plane touching the front of the rail.

In Figure 7, the cross-hatched area shows the maximum space available for the rail and its supporting structure; it does not take into account the fixing means for the rail. The remaining space is the maximum space which can be counted on as available for the equipment to be mounted on the rail.

Figure 8 shows magnified details of the edge of the rail, including the manufacturing tolerances. The angular tolerances indicated are one-sided and shall remain between zero and the values indicated. They include design tolerances.

APPENDIX A

STEEL MOUNTING RAILS

This appendix gives standard dimensions and manufacturing tolerances of steel mounting rails which meet the requirements of this standard.

A suitable material is cold-rolled carbon steel sheet, skin-passed after annealing bright surface finish, with a tensile strength between 320 N/mm² and 420 N/mm²; elongation at least 30%; 180° bend test horizontally and transversally with regard to the direction of rolling.

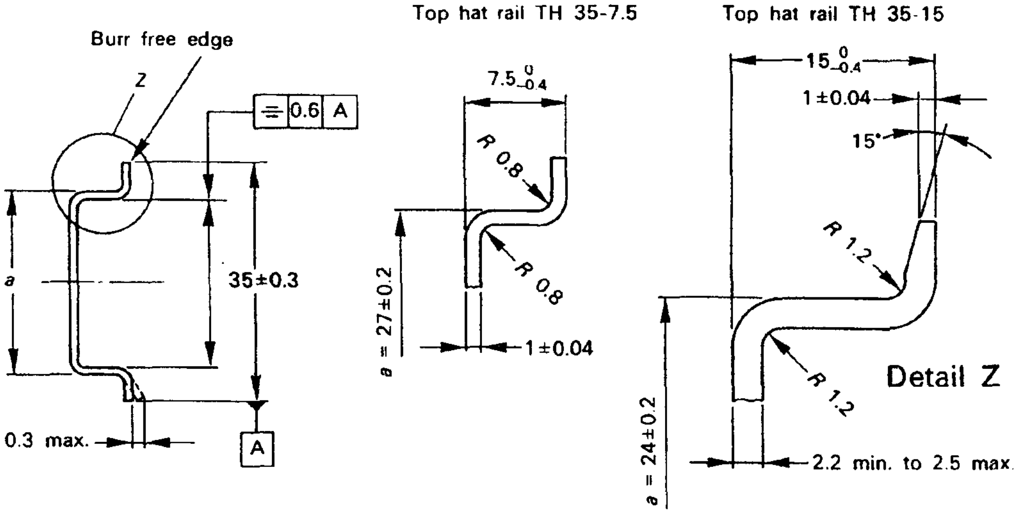
A1. **Top hat section rail TH 35-7.5 and TH 35-15**

A1.1 *Dimensions*

Dimensions stated for such rails are indicated in Figure A1.

These dimensions apply over the whole length of the top hat rail but shall not be verified at less than 10 mm from the ends.

Dimensions in millimetres



Top hat rail TH 35-7.5

Top hat rail TH 35-15

FIG. A1. — Top hat rails 35 mm wide for snap-on mounting of equipment.

Note. — The indication "burr free edge" may be made subject to agreement between manufacturer and user so as to ensure proper fitting in practical cases.

A1.2 *Tolerances on form*

Additional tolerances for rails which are provided as separate components.

The tolerances on form are shown in Figure A2, page 21, with symbols in accordance with ISO Recommendation R 1101/1.

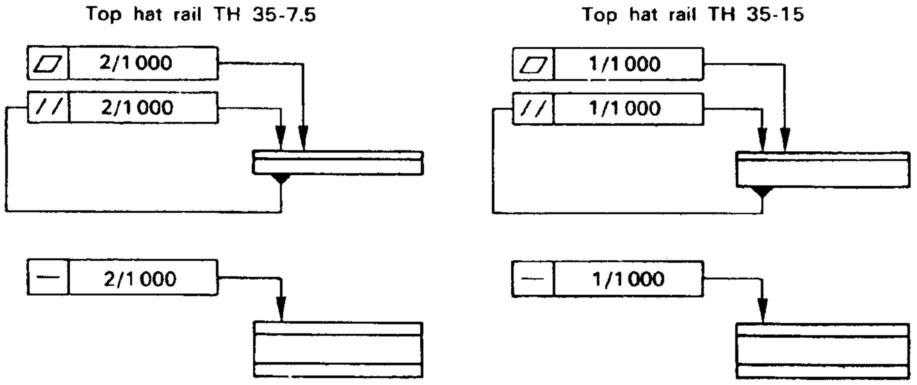


FIG. A2. — Tolerances on form.

A2. Top hat section rail TH 75-25

A2.1 *Dimensions*

Dimensions for such rails are indicated in Figure A3.

These dimensions apply over the whole length of the top hat rail but shall not be verified at less than 25 mm from the ends.

Dimensions in millimetres

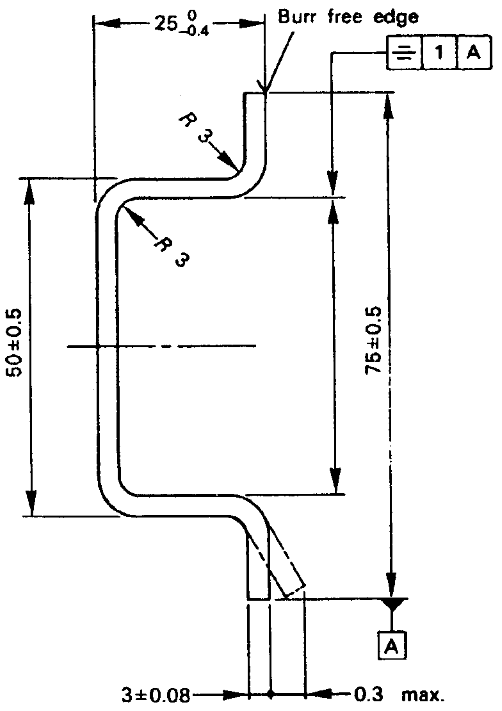


FIG. A3. — Top hat rail 75 mm wide
for snap-on mounting of equipment.

Note. — The indication "burr free edge" may be made subject to agreement between manufacturer and user so as to ensure proper fitting in practical cases.

A2.2 *Tolerances on form*

Additional tolerances for rails which are provided as separate components.

The tolerances on form are shown in Figure A4 with symbols in accordance with ISO Recommendation R 1101/1.

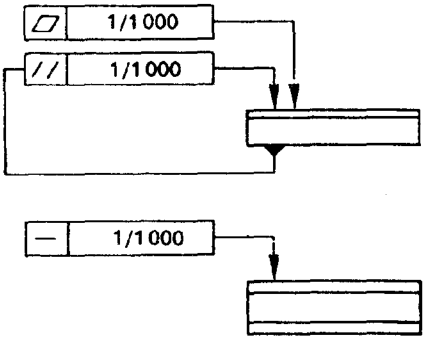


FIG. A4. — Tolerances on form.

A3. "C" section rail: C 20, C 30, C 40 and C 50

A3.1 *Dimensions*

Dimensions stated for such rails are indicated in Figure A5 and Table AI.

These dimensions apply over the whole length of the "C" section rail but shall not be verified at less than 10 mm from the ends.

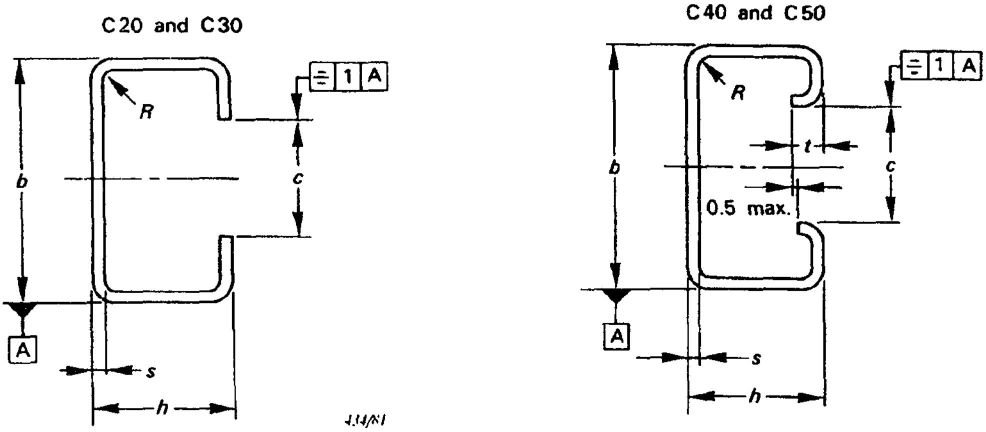


FIG. A5. — "C" section rails.

TABLE AI

Dimensions of "C"
section rails, in millimetres

Type	$b \pm 0.75$	$h \pm 0.75$	c	R_{max}	$s \pm 0.1$	$t \pm 1.2$
C 20	20	10	11 ± 0.3	1	1	—
C 30	30	15	16 ± 0.5	1.5	1.5	—
C 40	40	22.5	18 ± 0.5	2	2	5.5
C 50	50	30	22 ± 0.5	3	3	7

A3.2 *Tolerances on form*

Additional tolerances for rails which are provided as separate components.

The tolerances on form are shown in Figure A6 with symbols in accordance with ISO Recommendation R 1101/1.

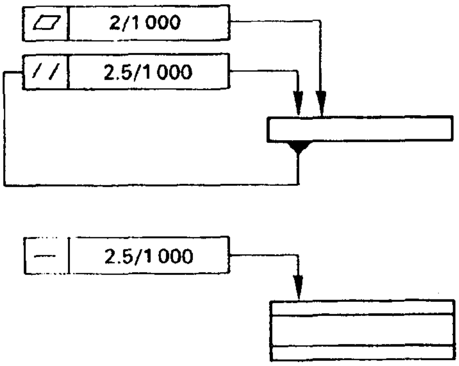


FIG. A6. — Tolerances on form.

A4. **"G" section rail: G 32**

A4.1 *Dimensions*

Dimensions stated for such rails are indicated in Figure A7, page 27.

These dimensions apply over the whole length of the "G" section rail but shall not be verified at less than 10 mm from the ends.

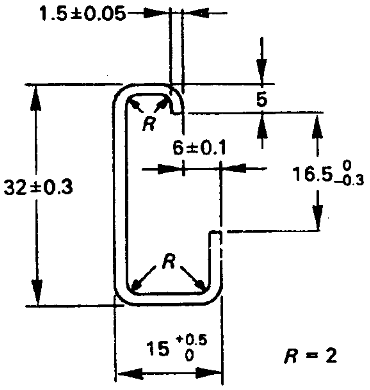


FIG. A7. — Dimensions of "G" section rails, in millimetres.

A4.2 *Tolerances on form*

Additional tolerances for rails which are provided as separate components.

The tolerances on form are shown in Figure A8 with symbols in accordance with ISO Recommendation R 1101/1.

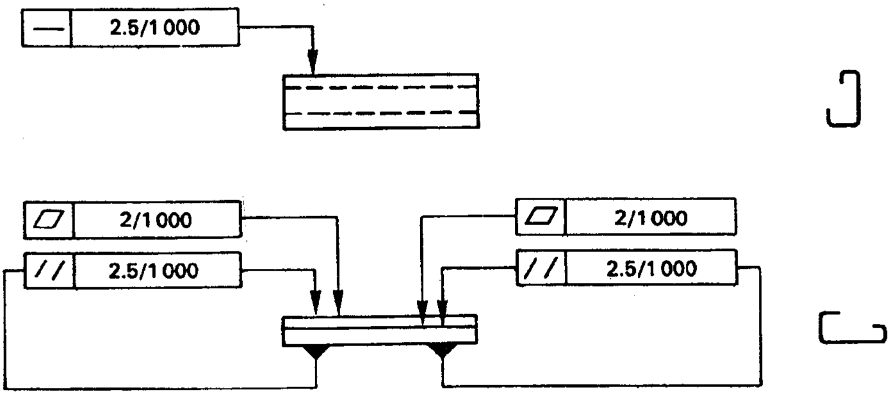


FIG. A8. — Tolerances on form.

APPENDIX B

APPLICATION GUIDE

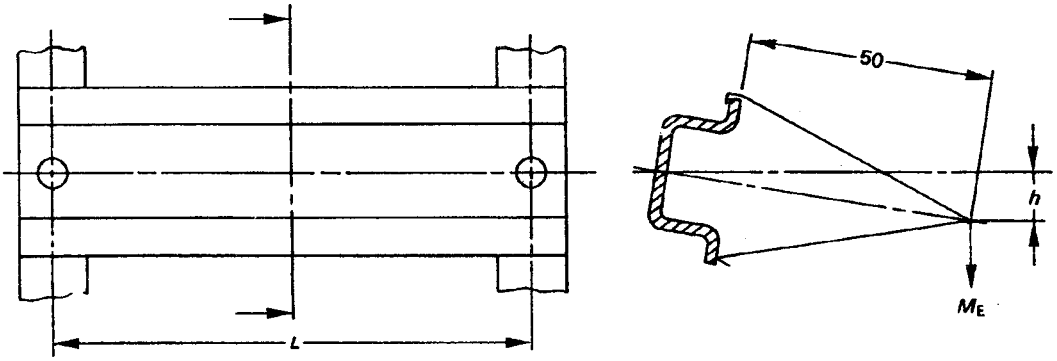
B1. Guidance for use of top hat rails

To determine the permissible load of rails, correctly used, the twisting deflection is always the most important factor. The sagging stress, on the other hand, is small and can be disregarded.

B1.1 *For steel rails in Appendix A*

Research has shown that as a result of the current practice of fixing rails by means of two screws, a torsion stress $\tau > 50$ N/mm^2 can cause a permanent deflection of the rail. The maximum permissible torque for that stress is independent of the distance between rail fixing points, for example 750 N · mm for a top hat rail TH 35-7.5. For distances between fixing points used in practice, an excessive deflection occurs generally at this load in the middle of the top hat rail.

A method for assessing this deflection is shown in Figure B1.



M = gear torque = weight × distance between the centre of gravity and the mounting plane of the device in N·mm (possible supplement to take shock into account)
M_E = moment in N·mm of the equivalent torque acting in the middle of the rail for a number of individual moments M of similar items of equipment:

$$M_E = \frac{\Sigma M}{2}$$

I_E = polar moment of inertia of the rail in mm^4
G = sliding modulus (steel plate 80000 N/mm^2)
L = distance between fixing points in millimetres
h = measure in millimetres of the deflection of the rail at 50 mm from the fixing surface of the equipment:

$$h = \frac{M_E \times L}{4\, I_E \times G} \times 50$$

FIG. B1. — Assessment of rail deflection.

B1.1.1 *Loading of top hat rails*

Using this method, the permissible load capacity M_E, as a function of the distance L between fixing points, has been calculated for three values of deflection h, for both types of rails and is shown in Figure B2, page 31, for rails TH 35-15 and TH 35-7.5 and in Figure B3, page 33, for rail TH 75-25.

B1.1.1.1 *Loading for TH 35-15 and TH 35-7.5 rails*

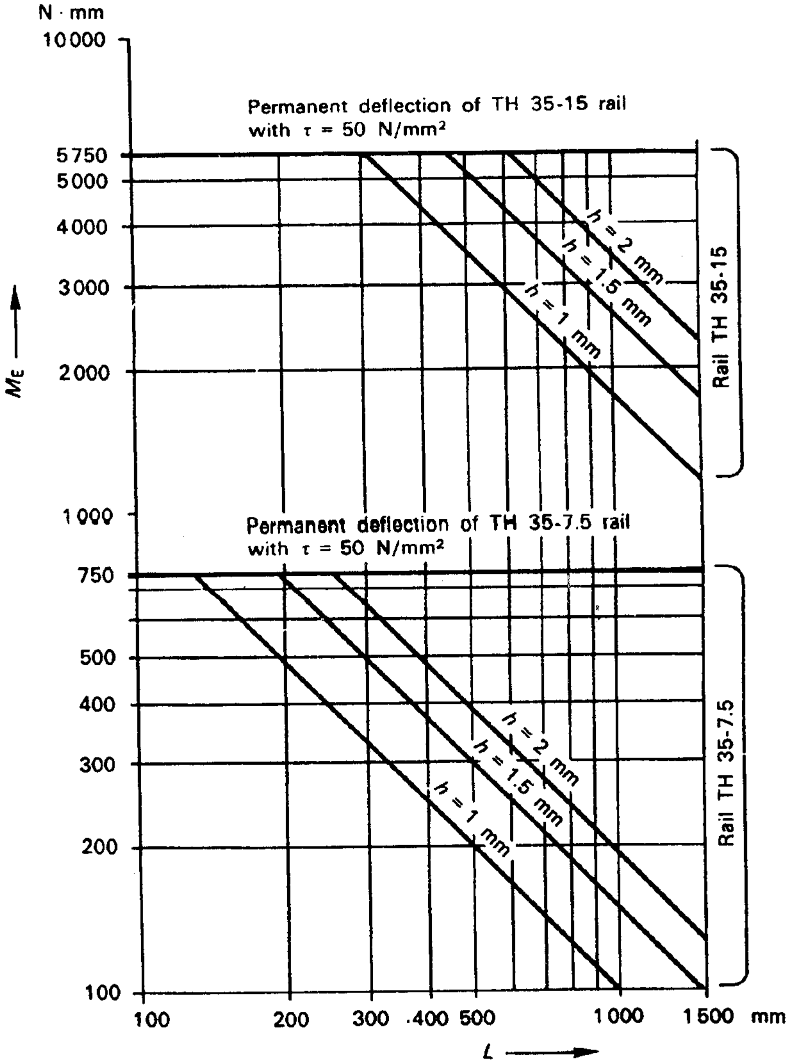


FIG. B2. — Permissible load capacity $M_E = f(L, h)$.

Examples

Example 1. – TH 35-7.5 $L = 300$ mm may be loaded with $M_E = 330$ N · mm for $h = 1$ mm.

Example 2. – It is required to use a rail 800 mm long to support items of equipment having an equivalent torque $M_E = 480$ N · mm for $h = 1$ mm.

First possibility: rail TH 35-15.

Figure B2, page 31, shows that $L = 800$ mm is convenient for $M_E < 2100$ N·mm.

Second possibility: rail TH 35-7.5.

Figure B2 shows that $L = 800$ mm is only convenient for $M_E \leq 120$ N·mm but that $L = 400$ mm is convenient for $M_E \leq 250$ N·mm. As 250 N·mm $> \frac{480}{2}$ N·mm, an intermediate fixing point at $L = 400$ mm is sufficient.

B1.1.1.2 *Loading for TH 75-25 rail*

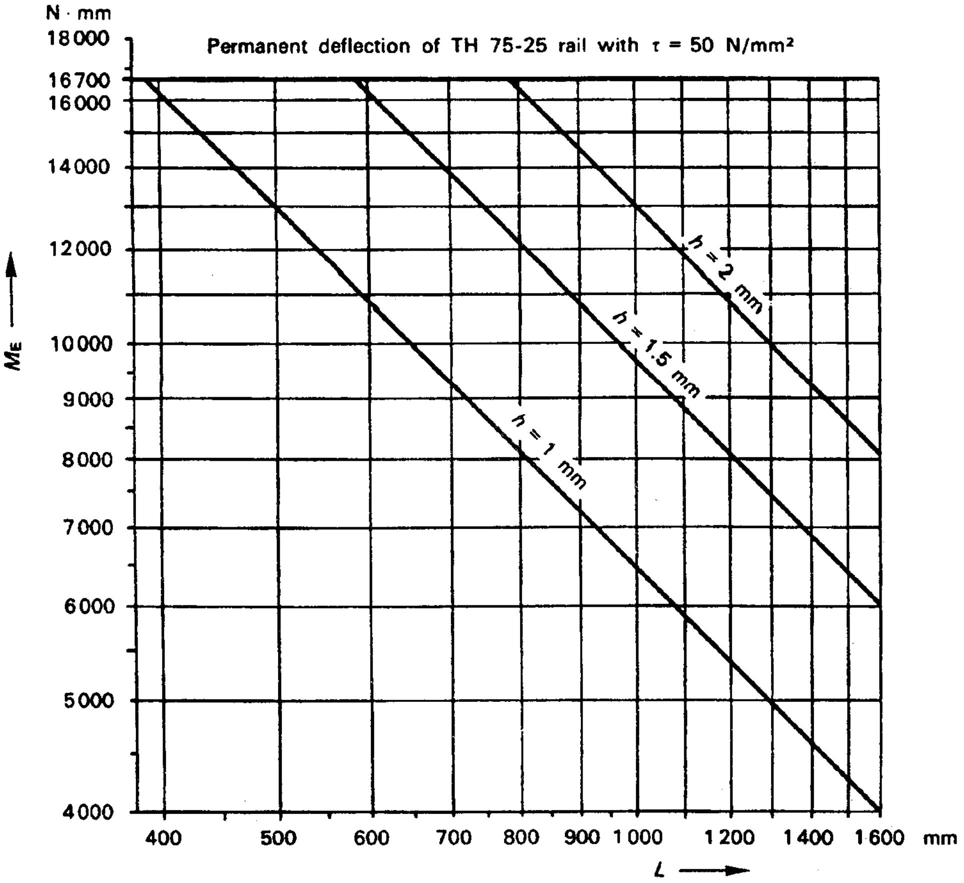


FIG. B3. — Permissible load capacity $M_E = f(L, h)$.

B1.2 *For rails other than steel rails*

For rails of material other than steel, loading data shall be given in the form detailed in Figures B2 and B3, pages 31 and 33 respectively, of this appendix and based on the methods for assessment of deflection shown in Figure B1, page 29.

B2. **Guidance for use of "C" section rails**

To determine the permissible load of rails, correctly used, the twisting deflection is always the most important factor. The sagging stress, on the other hand, is small and can be disregarded.

B2.1 *For steel rails to Appendix A*

Research has shown that as a result of the current practice of fixing rails by means of two screws, a torsion stress $\tau > 50\ \text{N/mm}^2$ can cause a permanent deflection of the rail. The maximum permissible torque, according to Table BI for that stress is independent of the distance between rail fixing points.

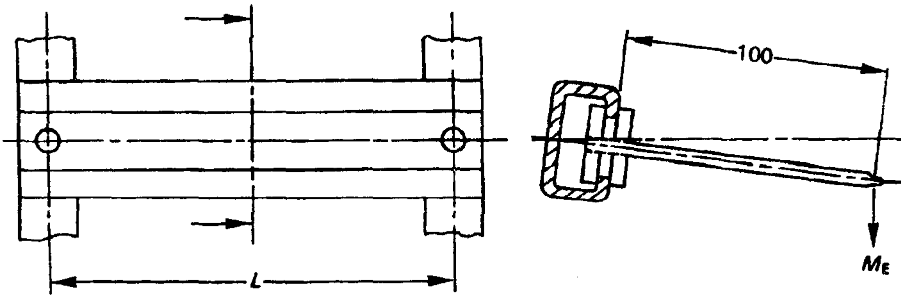
TABLE BI

Maximum torque M_{max}

"C" rail	C 20	C 30	C 40	C 50
M_{max} in N·mm	700	2 400	6 400	20 000

For distances between fixing points used in practice, with this force, an excessive deflection occurs generally in the middle of the rail.

A method for assessing this deflection is shown in Figure B4.



M = gear torque = weight × distance between the centre of gravity and the mounting plane of the device in N·mm (possible supplement to take shock into account)

M_E = moment in N·mm of the equivalent torque acting in the middle of the rail for a number of individual moments M of similar items of equipment:

$$M_E = \frac{\Sigma M}{2}$$

I_K = polar moment of inertia of the rail in mm^4

G = sliding modulus (steel plate 80000 N/mm^2)

L = distance between fixing points in millimetres

h = deflection in millimetres of the rail at 100 mm from the fixing surface of the equipment:

$$h = \frac{M_E \times L}{4\ I_K \times G} \times 100$$

FIG. B4. — Assessment of rail deflection.

B2.1.1 *Loading of one "C" section rail*

Using this method, the maximum permissible torque M_E, as a function of the distance L between fixing points, has been calculated for the deflection h = 1 mm and is shown in Figure B5, page 37. For other values of h^*, the torque M_{E*} may be calculated proportionally:

$$\frac{M_E}{M_{E*}} = \frac{h}{h^*}$$

at any rate without exceeding the value M_{max}, to avoid a permanent deflection of the rail.

In practice, deviations from the theoretical values may occur. Measurements have shown that the deflection h = 1 mm is reached for moments M_E shown in Figure B5, for distances L from 800 mm to 1 000 mm. For shorter distances, the deflection h may be reduced to 0.5 mm and, for greater distances, increased to 2 mm.

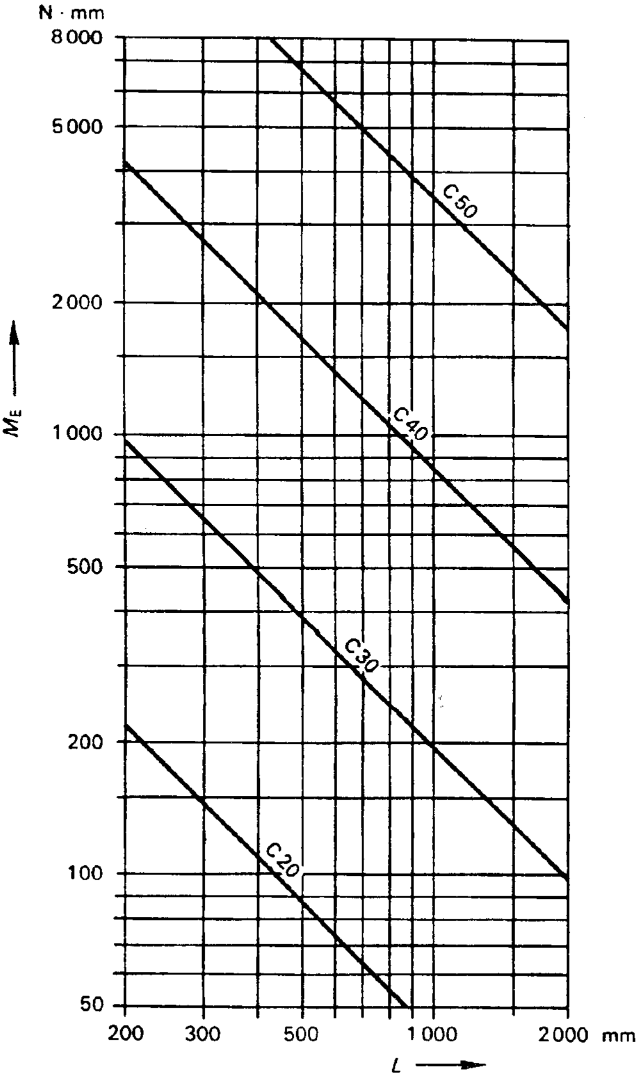


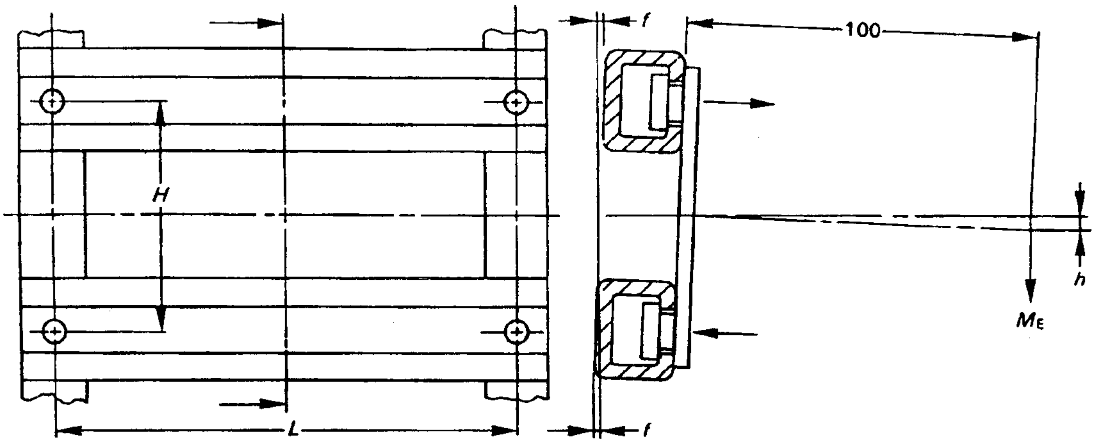
FIG. B5. — Permissible load capacity $M_E = f(L)$.

B2.1.2 *Loading of two "C" section rails*

To determine the permissible load capacity of an assembly of two identical "C" section rails, correctly used, the twisting deflection of the assembly resulting from the horizontal torsion *f* of each individual rail is always the most important factor. The vertical deflection, on the other hand, is small and can be disregarded.

Research has shown that, as a result of the current practice of fixing each rail by two screws, a torsion stress $\tau = 50$ N/mm^2 can cause a permanent deflection of the rail. The maximum permissible torque for that stress, according to Figure B7, page 41, is independent from the distance *L* between rail fixing points.

A method for assessing the deflection of the assembly is shown in Figure B6.



M_E = moment in N·mm of the equivalent torque acting in the middle of the rail for a number of individual moments M of similar items of equipment:

$$M_E = \frac{\Sigma M}{2}$$

J = moment of inertia of individual rails in mm^4
E = elasticity modulus (steel plate 210000 N/mm^2
L = distance between fixing points, in millimetres
H = distance between two rails, in millimetres
f = deflection of individual rails, in millimetres
h = value of the deflection of the assembly at 100 mm from the fixing surface of the device, in millimetres

FIG. B6. — Assembly of two identical "C" section rails.
Assessment of the deflection.

Using this method for an assembly with a distance H of 100 mm, the permissible stress M_E has been calculated and is shown in Figure B7 as a function of the distance L between fixing points of rails and for the deflection h = 1 mm.

According to the number, the lateral distance and the quality of the screwed connections between devices and rails, deflection slightly different from 1 mm can result for the assembly.

For different distances H^*, the permissible stress M_{E*} and the maximum stress M_{max*} can be computed by the formula:

$$\frac{M_E}{M_{E*}} = \frac{M_{max}}{M_{max*}} = \left(\frac{H}{H^*}\right)^2$$

For a smaller or a greater deflection h^*, the stress M_{E*} can be obtained by the ratio:

$$\frac{M_E}{M_{E*}} = \frac{h}{h^*}$$

still without exceeding the corresponding maximum stress M_{max} or M_{max*}, to avoid any permanent deflection of rails.

B2.2 *For rails other than steel rails*

For rails of material other than steel, loading data shall be given in the form detailed in Figures B5 and B7, pages 37 and 41 respectively, of this appendix and based on the methods for assessment of deflection shown in Figures B4 and B6, pages 35 and 37 respectively.

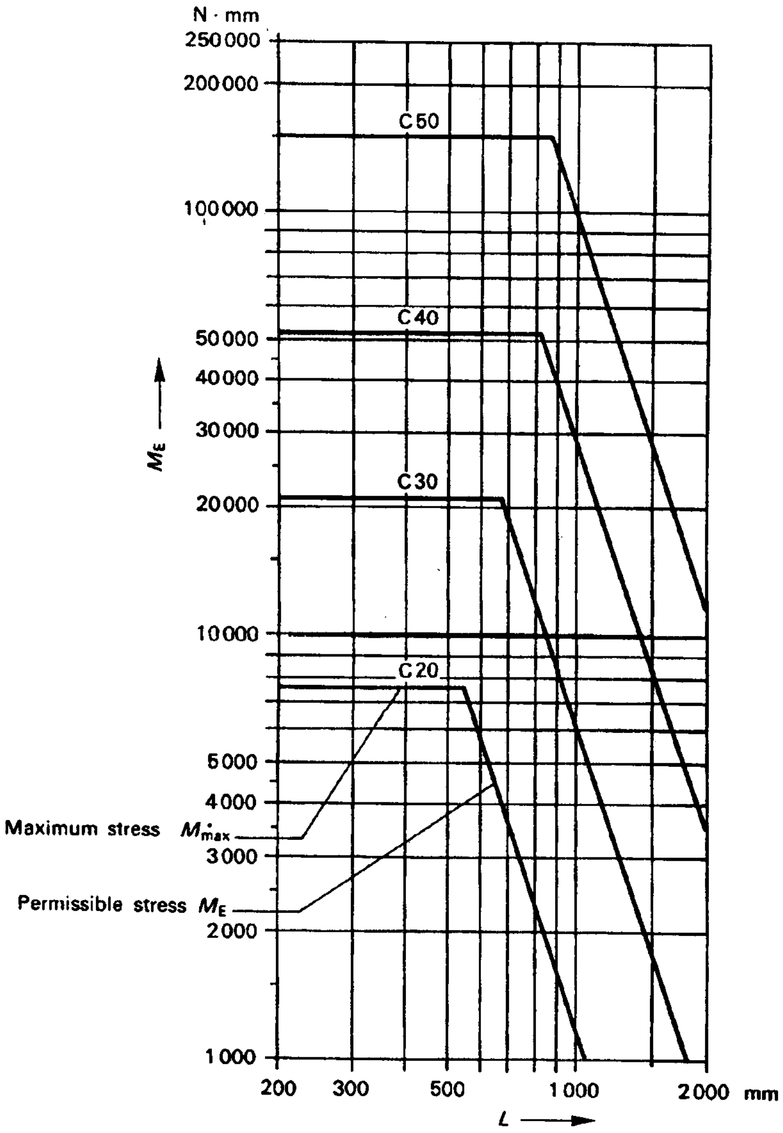


FIG. B7. — Assembly of two identical "C" section rails.
Permissible stress $M_E = f(L)$ for H = 100 mm.

AMENDMENT NO. 1

Page 11

4.1 *Top hat section*

Add the following figures to figure 1 and figure 2, respectively:

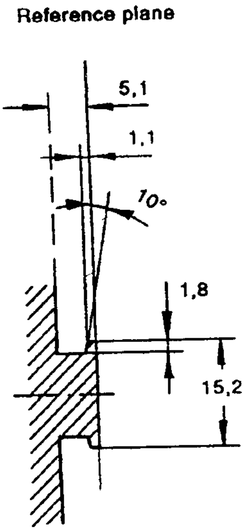


Figure 1

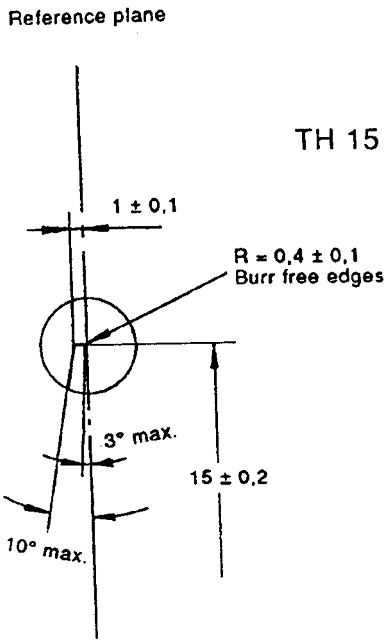


Figure 2

Annex A

Steel mounting rails

Replace the first two paragraphs by the following text:

This annex gives guidance for the selection of steel and finish, and specifies the standard dimensions and manufacturing tolerances of steel mounting rails which meet the requirements of this standard.

A suitable material is a cold-rolled carbon steel sheet having the following characteristics:

- skin passed after annealing;
- bright surface finish;
- tensile strength between 320 N/mm² and 420 N/mm²;
- elongation at least 30 %;
- 180° bend test horizontally and transversally with regard to the direction of rolling.

A suitable finish is zinc-plating and chromating, with a layer having a thickness of at least 6 µm, except for the cut surfaces resulting from cutting to length.

Other qualities of steel and other finishes may be used by agreement between manufacturer and user.

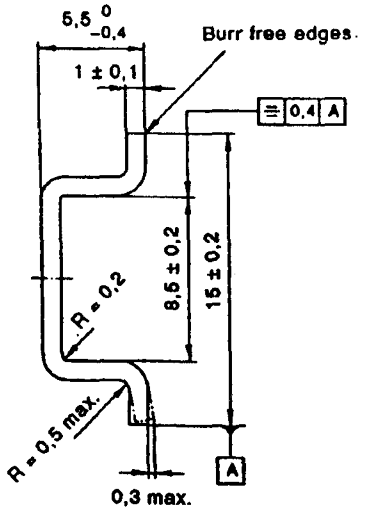
Insert the following new clause:

A0 Top hat section rail TH 15-5,5

A0.1 *Dimensions*

The dimensions stated for such rails are indicated in figure A.9.

These dimensions apply over the whole length of the top hat rail but shall not be verified at less than 10 mm from each end.



Dimensions in millimetres

Figure A.9 – Top hat rails 15 mm wide for snap-on mounting of equipment

A0.2 *Tolerances on form*

Additional tolerances for rails which are provided as separate components.

The tolerances on form are shown in figure A.10 with symbols in accordance with ISO 1101*

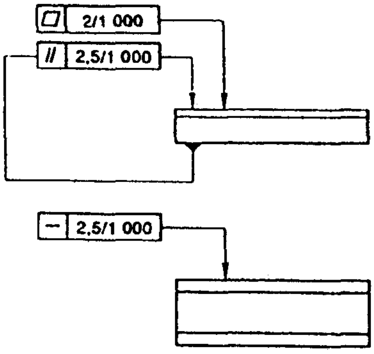


Figure A.10 – Tolerances on form

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* ISO 1101: 1983, Technical drawings – Geometrical tolerancing – Tolerancing on form, orientation, location and run-out – Generalities, definitions, symboles, indications on drawings

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